Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	WT Docket No. 97-12
	)	
Amendment of Part 97 of the	)	RM-8737
Commission's Rules Governing	)	
the Amateur Radio Service to	)	
Facilitate Spread Spectrum	)	
Communications	)	

To: The Commission

REPLY COMMENTS OF LYLE JOHNSON, WA7GXD

INTRODUCTION

My name is Lyle Johnson, and I operate amateur radio station WA7GXD. I have been a licensed radio amateur since early 1964 at age 13, and presently hold an Amateur Extra class license. I am not engaged in any commercial aspect of amateur radio. I have long been a volunteer engineer for TAPR and AMSAT, have materially contributed to several amateur satellites, and made significant contributions to the technical and organizational aspects of TAPR from its founding. It is from the perspective of a freely-contributing "do-er" that I offer the following input to this proceeding.

Of the 14 comments filed in this proceeding to which I have access, 12 "generally agree"[1] with the proposal to relax restrictions on Amateur use of SS radio techniques. Both of the comments filed which raise serious doubt [2] are from Part 15 suppliers whose equipment or services operate in the ISM bands.

I wish to reply to a number of the comments filed in this proceeding.

Record Keeping Requirements

This issue was raised by TAPR, WA7GXD, KA9Q and the Manager of the National Communications System (hereinafter referred to as "NCS"). All comments were for the relaxation of the burdensome record keeping (Part 97.311(e)) required of amateur SS stations. No commenters addressed any need to retain the current level of record keeping, nor were any arguments advanced to justify them.

Thus, I ask the Commission to carefully consider the comments made in this regard and to delete this burden from those who wish to experiment with and help further develop the uses of spread spectrum communications in the Amateur radio service.

Power Limits

100 Watt Limit

Regarding the 97.311(g) proposal to retain the existing 100 watt transmitter power output limit, I note the following:

Retain as proposed	WA7GXD
Increase to 1500 watts	KA9Q (for space), TAPR
Didn't specifically comment	Part 15, CSVHF (and N7STU), ARRL, 220SMA, Metricom, NCS, K6KGS, W2RS, W3XO, AMSAT

No comments were filed that requested the Commission to reduce the maximum Amateur power limit of 100 watts for SS under this Proceeding.

I originally commented that the 100 watt power limitation was reasonable. I had not considered EME operation, nor possible planetary or deep-space missions. In light of these reasonable considerations, I ask the Commission to remove the arbitrary 100-watt power limitation for SS operation and allow SS the same status as any other Amateur mode on the frequency band in which it is used.

KA9Q suggests that the language of 97.313(f) maybe used to protect terrestrial users of these frequencies. If the Commission believes that such protection is necessary, I concur with the comments of KA9Q.

Automatic Power Control

Regarding the proposal to codify a requirement for Automatic Power Control, I note the following responses:

Retain as proposed	ARRL
Dispose of proposal	TAPR, KA9Q, 220SMA, K6KGS, WA7GXD
Won't do any good	CSVHF (and N7STU), Part 15 Coalition, Metricom
Didn't comment	NCS, W2RS,W3XO, AMSAT

I think it is reasonable to conclude that the majority of commenters either think the APC requirement is a bad idea or are neutral on it. Only the ARRL specifically commented that it was a good idea.

As pointed out by KA9Q, the idea of including APC in the Petition of December, 1995, originated with him as a member of the ARRL Digital Committee. KA9Q has now gone on record in these proceedings as agreeing that APC is not workable under all circumstances and should be dropped as a requirement for Amateur SS communications.

Automatic Power Control is not consistent with normal Amateur communications goals and practice (see comments of TAPR, KA9Q and WA7GXD), and has been shown by several commenters as not being able to achieve its desired goal in many cases. Even those who oppose expanded Amateur use of SS emissions contend that APC will not seriously mitigate the interference potential they fear.

And, many commenters point out that Part 97.313(a) already requires stations to use the minimum necessary power for the intended communication.

Since the proposed 97.311(g) APC provision will necessarily add to the complexity of an SS system, will delay the goal of increased experimentation with SS in the amateur bands, is redundant with 97.313(a) and will not achieve the goals claimed for it in the original petition, I respectfully request the Commission to delete this requirement from the proposed rules.

Exclusion from ISM Bands
Interference to Existing Unlicensed Devices
Use of Part 15 Devices with High-Power Amplifiers

I have combined these issues as they are all closely related.

Metricom argues that Amateurs don't need to operate in the 915 MHz, 2.4 GHz or 5.8 GHz bands because Part 15 devices already operate in these segments. They wish to preclude Amateur SS operation on bands *for which it is already an authorized mode!*

The essence of their arguments are (1) Part 15 operations have already demonstrated that SS works in these bands, so the Amateur community need not investigate and (2) a consistent reference to 100 watt transmitters and unlimited gain antennas that will disrupt unlicensed operations.

The Part 15 Coalition expresses the fear that if the NPRM is adopted, large numbers of Amateurs would rush to buy Part 15 devices, add power amplifiers, and wreak havoc in a "delicately balanced" portion of the spectrum.

I wish to reply to the scenarios raised by these commenters.

It is hard to imagine Metricom's proposal to essentially ban Amateur SS activity in the shared ISM bands is serious. One could use the same logic to argue that since narrowband FM has been shown to work commercially at 174 MHz, Amateurs should not be allowed to operate on 2-meter FM! Or, one could as reasonably argue that since there are commercial CDMA (spread spectrum) cellular telephones in the 900 MHz region of the spectrum, Part 15.247 operations should therefore not be allowed at 915 MHz...

The point of Amateur investigation and experimentation is not necessarily to prove whether SS might work in the shared ISM bands. It may be to investigate propagation phenomena, research multi-path mitigation, or to leverage available IC technology in an effort to minimize the cost of SS station development. It may simply be to facilitate normal Amateur communications, including emergency and disaster-related traffic. Different frequency bands have different characteristics, and to preclude investigation of those characteristics seems contrary to the basis and purpose of the Amateur service. It also seems rather arrogant of a completely unlicensed service in an area of spectrum shared by multiple services to dictate what a currently licensed (and previously licensed before the Part 15 devices were deployed) service may or may not do.

However, close reading of the Metricom comment, and the related concerns expressed by the Part 15 Coalition comment, reveal the real issue: concern for interference to existing Part 15 devices and services. Let's look closer at the arguments raised.

Surprisingly, the Part 15 Coalition states:

> "For instance, by expanding the range of spread spectrum transmission modes that may be used by amateur radio stations, operators who have little or no technical knowledge will now be able simply to purchase and use Part 15 spread spectrum equipment that is widely available in the market."

Is this not what **anyone** can already do? Is the implication that an amateur radio licensee is somehow less technically knowledgeable than the average citizen who can buy this same equipment? How does a change in amateur rules relate to interference caused to Part 15 devices by other Part 15 devices?

Metricom, in particular, consistently raises the specter of hordes of 100-watt transmitters with "unlimited gain" antenna systems disrupting their metropolitan wireless services. The Part 15 Coalition suggests that Amateurs will implement this by using existing Part 15 devices fitted with added power amplifiers.

Let's look at current narrowband practice, then expand our look to available technology, to weigh the reasonableness of these assertions.

Amateurs are currently allowed 1500 watts power output on most VHF and UHF bands. Commercially available amplifiers exist for these frequencies. Yet, the vast majority of Amateurs on these bands are content to run 1-watt class handheld radios and 25-50 watt mobile and base stations. Even satellite operators rarely exceed 100 watts of actual RF.

EME (earth-moon-earth, or moonbounce) has been an Amateur activity for nearly fifty (50) years, with suitable equipment commercially available for the last 20 years. The most recent ARRL EME contest was held in September, 1996. The results, published in the May, 1997 issue of QST, tabulate only 58 stations in the entire United States (including Alaska) reporting their participation. Of these, only 11 were at frequencies above 432 MHz.

Clearly, the mere fact that high-powered operation of UHF stations with highly-directive antennas is allowed under Part 97 rules does not reasonably lead to the conclusion that a significant portion of the Amateur community operates such stations. Consider there are well over 300,000 licensed Amateur operators today, and that a large fraction of them are currently active on the VHF and UHF bands.

High-gain (really, high-directivity) antenna systems require space, and most metropolitan areas (where Metricom has services) don't afford Amateur operators the luxury of large antenna systems, either because of the realities of multi-family dwellings (e.g., apartments, condos) or restrictive covenants and neighborhood associations (townhouses, gated communities).

For the relatively few Amateurs who might utilize highly-directive antennas, any potential interference is reduced to the beamwidth of the antenna. Most Amateur operations are intermittent in nature, so such potential interference will be both geographically restricted and infrequent.

Further, the net effect of the feared interference is just another case of the well-known near-far problem. It seems unreasonable to assume in a metropolitan area that a higher-powered Amateur station is likely to be much stronger at a given Metricom "cell site" than the nearby intended users to whom Metricom is selling its service. Further, it is reasonable to assume that the design of the Metricom system must have been such as to accommodate potential interference from the other ISM-band users, including higher powered Amateur stations.

Finally, even if amateur SS operation does become widespread, it will be a number of years before such operations become commonplace. This gives Metricom and others plenty of time to re-engineer their systems to allow for the increased occupation of the shared bands if they have not already done so. Most Part 15 SS equipment only achieves 12 dB or so of spreading gain, near the minimum specified by Part 15.247. These systems could easily be designed to provide another 10dB or 20 dB of spreading gain, more than enough to offset any increased Amateur transmitter power. Thus, there are readily available technical solutions to the perceived problem, which should have been already incorporated into Part 15.247 equipment..

Let us now consider the argument that Amateurs will flock to the sellers of Part 15 SS equipment and add power amplifiers as soon as the new rules come into effect.

First, commercial Part 15 equipment is not cost effective in the Amateur market. For example, a frequency-hopping, 1 watt 915 MHz SS transceiver from Freewave Technologies costs about $1295 in unit quantities. Amateurs are used to getting multi-band, multi-mode, 50-100 watt HF or VHF/UHF radios for under $1,000. Most single-band, single-mode equipment (whether for VHF, UHF or HF) costs under $600, and often less than $400. Why would an Amateur want to spend $1295 for a radio that then needs to

be modified to make it suit his purposes? And if it is to be run at Part 15 power levels, the Amateur would more likely operate it as an unrestricted Part 15 device, than as a content-restricted Part 97 device.

How practical is it to generate 100 watts of RF power on 915 MHz or 2.4 GHz?

Two current major suppliers of Amateur equipment for these bands are Down East Microwave and SSB Electronics USA. Checking their Web pages in late May, 1997, shows that the highest power 915 MHz amplifier available is 35 watts. It would take four (4) of these amplifiers plus a combiner to create a 100-watt signal. This would cost well over $2,000. Thus, for the Part 15 Coalition's fears to be realized, the individual Amateur would have to be willing to spend around $3500 (plus antenna). Few Amateurs have stations whose total station equipment costs that much! It is unreasonable to assume that many Amateurs would want to spend $3500 for a modified Part 15 radio.

At 2.4 GHz, the costs are even higher. On this band it costs nearly $600 to get a 10 watt amplifier, the most powerful generally available to Amateurs. It would thus cost several thousand dollars to generate 100 watts at 2.4 GHz using currently available systems. Again, very few Amateurs would be willing to spend this sum for such a specialized piece of equipment

Clearly, the fears expressed by the Part 15 coalition are not based on reasonable assumptions.

For amateur SS to work, there will have to be development work done in the amateur community for systems which meet amateur needs. The stated reason for this rule-making is to allow such experimentation to flourish. I suspect the outcome, if the rules are adopted with changes in the APC narrow-band ID and record-keeping requirements, will be the development over a reasonable period of time of low-cost, high-capability amateur-tailored SS equipment. And it will necessarily be low power due to cost -- the range of 1-10 watts at 2.4 GHz and 1-30 watts at 915 MHz seems reasonable.

Spectrum Management/Frequency Coordination

The 220 MHz Spectrum Management Association requests specific rules to allow enforcement of local band plans be added to the proposed SS rules for Part 97. I wish to go on record as resisting this effort.

Most VHF and UHF bands in crowded metropolitan areas have coordinated repeaters. There are no more channels left to be coordinated. Yet, as K6KGS measured and documented in his comments, a scan of the band will show that the spectrum is hardly utilized, with only about 10% of its capacity ever used.

This is because the present methods of frequency coordination are actually a means of frequency "warehousing" where a local body grants a licensee exclusive use of a repeater channel in an amateur band. The owner of the coordinated repeater, however, is not then required to show sufficient activity to justify continued protection for the frequencies used.

The nature of SS systems is such that they seek to avoid narrowband interference. A frequency hopper, for example, should be designed to note that if dwelling on certain frequencies for a hop time results in poor throughput, it should skip over that channel in its hopping algorithm. In this way, it would minimize interference to narrowband users who are actually using a coordinated channel, yet be able to use unoccupied channels when they are simply "set aside" for repeaters but not actually in use.

Until a method of frequency coordination is evolved that takes into account the efficient and beneficial use (to the amateur community at large, not merely the repeater owners) of coordinated spectrum, I think it is a very bad idea to attempt to regulate an infant mode such as SS using outdated methods and concepts of "spectrum management." Let the systems be developed and deployed, then let amateurs of good will seek to resolve whatever problems might arise in mutual cooperation. Amateurs have long been noted for their pragmatic approach to solving problems of interference, and there is no evidence documented in this proceeding to suggest that they will not continue to do so.

I request the commission not make any special rulemaking concessions to the well-intended but inapplicable position put forth by the 220 MHz Spectrum Management Association.

EME
Frequency Sub-bands
Weak Signal Operation
Rising Noise Floor

I have grouped these topics together as they appear to be strongly related in the comments filed in this proceeding.

A number of commenters went on record opposing the use of spread spectrum in the so-called "weak signal" portions of the Amateur bands (W3XO, CSVHF and N7STU, AMSAT, W2RS). In some cases, calculations were put forth as evidence that allowing SS operation in these band segments would raise the noise floor by many tens of dB, rendering traditional narrowband weak-signal operation impossible.

I believe these arguments are well-intentioned, but unrealistic.

An EME station necessarily points its antennas at the moon. Further, in order to maximize the possibility of a successful contact, the antenna arrays used are highly directive. This means that the raising of the noise floor by SS would have to be coming from the moon. Since there are not likely to be a large number of SS stations actually on the lunar surface, these signals will have to be bounced off the moon along with the desired narrowband signals. This would require an extremely large number of SS stations running high power directed at the moon for the spectral power density to raise the noise floor a perceptible amount. If I had a high-power SS station trying to communicate terrestrially, I would not want my signal energy to go to the moon, so I would use an antenna system that did not direct it there. So would most other reasonable people.

On the other hand, if I wanted to set up an EME link, I would very likely want to use SS methods to help mitigate the inherent multipath. This would make me a high-powered, weak signal station just like the other EME stations. I should be allowed to use the same frequency spectrum as they use. If I cause interference, I will reconfigure my station so as to minimize that interference (and, presumably, minimize the interference to my operations caused by their high-powered, narrowband emissions).

In other words, a gentlemen's agreement will come into play if one is needed, much the same as PACKET, AMTOR, RTTY, CLOVER, G-TOR and other digital modes share limited spectrum on the 20-meter HF band, without special rules or other imposed methods.

If I am a terrestrial weak-signal operator, I will do the same thing. It is in the best interests of all Amateurs to cooperatively share the precious spectrum resource we are granted by a generous public policy towards Amateur radio operations.

Some commenters suggest that a "narrowband SS" class be established for weak-signal operation, and a "wideband SS" class be established for all other types of operation. This is like setting aside some spectrum for CW at 5 WPM and slower, and another for CW at 20 WPM and faster. It assumes that no serious weak-signal work could be done if the SS signal is wider than some arbitrary limit (in the range of 3 to 10 kHz), or that such SS emissions will somehow cause less interference to narrowband weak-signal stations than wider ones.

What if research into the physics of the motion of the moon and the nature of a particular frequency band showed an optimum bandwidth for effective EME communications at lunar perigee to be 12.9 kHz? The proposals by the "narrowband SS" proponents would make such operation impossible, and deny the very people seeking this provision the very means of their greater success!

proposals by the "narrowband SS" proponents would make such operation impossible, and deny the very people seeking this provision the very means of their greater success!

I suggest that, rather than impose such arbitrary rules, and codify limited-use modes as having some sort of superior claim on Amateur spectrum, that we leave things as they are and allow technical imperatives and social cooperation to work. Only if such cooperation is demonstrated to be ineffective should we appeal to our regulators for assistance in solving our problems.

Narrow Band Identification

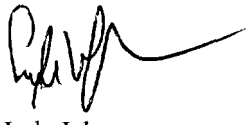
Several commenters requested that the narrow band ID requirements of Part 97.119(b)(5) be eliminated. No commenters argued for retaining this provision. I ask the Commission to rescind this part of the existing SS regulations as part of this proceeding, based on the arguments already presented during the public comment period.

CONCLUSION

I respectfully ask the Commission to implement the proposed amateur SS rules in this proceeding with the specific changes of: increased power to that of all other modes in a given amateur band, elimination of the automatic power control proposal, simplification of station record keeping, and elimination of the narrowband ID requirement.

Thank you for the opportunity to reply to the comments filed in this proceeding.

Respectfully submitted,



Lyle Johnson

(1) AMSAT, TAPR, ARRL, WA7GXD, W2RS, Central States VHF Society, W3XO, 220 Spectrum Management, KA9Q, K6KGS, Manager of National Communication System, N7STU (echoing CSVHFS)

(2) Part 15 Coalition, Metricom.